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Original Article

Global Trends in Micro-CT Studies of Root Canal Morphology: A 25-Year Bibliometric Analysis

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CLINICAL SIGNIFICANCE

Micro-CT offers precise, non-destructive visualization of canal morphology, providing valuable insights into complex internal anatomy. These insights have improved the understanding of canal configurations, refined experimental models, and guided the advancement of clinical techniques and instrumentation strategies endodontic practice.

ABSTRACT

Objectives: This study aimed to conduct a bibliometric analysis of publications on the use of micro-computed tomography (micro-CT) in root canal morphology research to map scientific output, assess collaboration patterns, and identify thematic trends.

Materials and Methods: Articles published between 2000 and 2025 were retrieved from the Web of Science Core Collection (WoSCC), limited to the Science Citation Index Expanded (SCI-Expanded). After applying the inclusion and exclusion criteria, eligible studies were analyzed by publication year, authorship, country of origin, journal and keyword occurrence. Data were processed using Microsoft Excel, and bibliometric networks were visualized in VOSviewer (v1.6.15).

Results: Publication output increased steadily after 2010, reaching a plateau during 2020. Brazil, the United States, and China were the most productive countries, together contributing over 60% of all SCI-indexed articles, while Türkiye, Germany, and Switzerland also showed notable growth. Versiani, Sousa-Neto, and Keleş were among the most prolific and influential authors. Keyword mapping revealed three main clusters: instrumentation and preparation, imaging-based anatomical analysis, and cone-beam computed tomography.

Conclusion: Micro-CT has become an essential imaging tool in endodontic morphology research, allowing precise three-dimensional evaluation of root canal anatomy. Although it was initially used mainly for validation purposes, it has progressively evolved into a comprehensive tool for detailed assessment of root canal morphology and quantitative analysis in endodontic studies.

1. Introduction

Understanding the complex three-dimensional morphology of the root canal system remains one of the most critical factors influencing the success of endodontic therapy. Incomplete knowledge of internal anatomy can result in missed canals, inadequate cleaning, and persistent infection, all of which may lead to endodontic failure.[1] Traditional imaging modalities have provided valuable information about canal anatomy; however, their two-dimensional limitations often prevent an accurate appreciation of internal morphology, canal curvature, and anatomical variations. These constraints have driven the continuous development and adoption of advanced imaging technologies in endodontic research.[2]

Micro-computed tomography (micro-CT) has emerged as the widely accepted reference method for non-destructive, high-resolution three-dimensional imaging of dental hard tissues. This technique allows precise visualization and quantitative evaluation of root canal morphology, including canal number, shape, curvature, volume, surface area, and accessory structures.[3] Compared with histological sectioning and radiographic methods, micro-CT provides superior spatial resolution and reproducibility while preserving the specimen integrity. Consequently, micro-CT has become an indispensable tool in studies of internal root anatomy, instrumentation efficacy, sealer penetration, obturation quality, and morphological variations among different populations and tooth types.[4]

Since its first applications in dental research during the early 2000s, micro-CT has progressively transformed endodontic research methodologies.[4] Early studies focused primarily on validating its accuracy and reliability relative to conventional techniques.[5–7] Subsequently, as scanner availability increased and analytical software advanced, researchers began to explore the technology's potential to quantify complex anatomical details and to compare pre- and post-instrumentation morphology.[8,9] These methodological advances have contributed to significant progress in understanding canal configurations, apical anatomy, isthmus prevalence, and the effects of age, ethnicity, and clinical interventions on root canal systems.[10–12] Furthermore, the incorporation of micro-CT–based datasets into digital modeling and artificial intelligence pipelines has expanded its relevance beyond pure morphology studies, positioning it as a central research instrument in endodontic innovation.[13,14]

Although several overviews[4,15,16] have addressed the general applications of micro-CT in dentistry, no comprehensive bibliometric analysis has specifically focused on its use in root canal morphology — one of the most extensively investigated areas within endodontic research. Bibliometric analysis provides a quantitative approach to filling this gap by mapping scientific output, evaluating authorship and collaboration networks, and identifying thematic evolution across time. Such analyses not only highlight the trajectory of technological integration but also reveal geographic and institutional trends that shape the global distribution of endodontic research activity.[17] Analyzing publication output, citation impact, author and country collaborations, and keyword co-occurrence can reveal both established and emerging themes that define this research domain.[18] Furthermore, identifying the most active contributors, core journals, and leading countries provides valuable insight into the academic landscape supporting innovation in endodontic

imaging.[19] This study differs from previous bibliometric assessments by focusing exclusively on micro-CT applications in root canal morphology, rather than general dental or imaging contexts. Earlier studies often presented different dental applications of micro-CT,[15] limiting the ability to identify morphology-specific trends, author networks, and technological evolution. By refining the dataset to include only SCI-indexed studies explicitly addressing root canal anatomy, the present work provides a targeted and methodologically standardized overview of how micro-CT has shaped endodontic morphology research over the past 25 years.

2. Materials and Methods

2.1. Study Design

This bibliometric analysis was conducted in accordance with established guidelines for reporting bibliometric studies in biomedical research.[20]

2.2. Search Strategy

A cross-sectional bibliometric analysis was conducted to assess global publication trends on the use of micro-CT in research on root canal morphology between 2000 and 2025. The literature search was carried out on September 20, 2025, using the Web of Science Core Collection (WoSCC) database, which includes the Science Citation Index Expanded (SCI-Expanded). The search strategy employed the keywords "*micro-CT*" OR "*micro-computed tomography*", "*morphology*" OR "*anatomy*", and "*endodontic*" OR "*root canal*" in the "*All Fields*" category. The exact search string was as follows: (*micro-CT* OR *micro-computed tomography*) AND (*morphology* OR *anatomy*) AND (*endodontic* OR *root canal*). The initial search yielded 506 records. After excluding conference proceedings, letters, editorials, and notes, and limiting the results to original research articles and review papers published in English, the dataset was refined by applying the publication year filter (2000–2025). After detailed evaluation, studies unrelated to the use of micro-CT in endodontic morphology research were excluded. The "full records and cited references" of each included article were exported from WoSCC in plain-text format to ensure compatibility with bibliometric analysis software.

2.4. Data analysis

Data obtained from the WoSCC database were organized and analyzed in Microsoft Excel 2021 (Microsoft, USA) to perform preliminary data management, descriptive evaluation, and trend analysis. Network visualization was performed using the VOSviewer software (version 1.6.15; Centre for Science and Technology Studies, Leiden University, Netherlands). The overall workflow of the study was presented in Fig. 1.

Publication output and citation counts were calculated. Country-level publication data were extracted from the WoSCC dataset. The co-authorship analysis was performed in VOSviewer (v.1.6.15) using the full counting method. A minimum threshold of 2 documents per author was applied. The resulting data were organized to identify the most prolific contributors. Country-level analyses were conducted under the same condition. Additionally, a thesaurus file was used to merge the country name variants "*Turkey*" and "*Turkiye*" under the standardized label "*Türkiye*" to ensure consistency in the co-authorship and collaboration networks. The distribution of publications across journals was analyzed, and the top 10 journals were identified based on record counts. A keyword co-occurrence network was constructed to reveal thematic clusters. The minimum occurrence threshold for inclusion was set at 3 for author keywords to include only terms with consistent relevance. A thesaurus file was created in

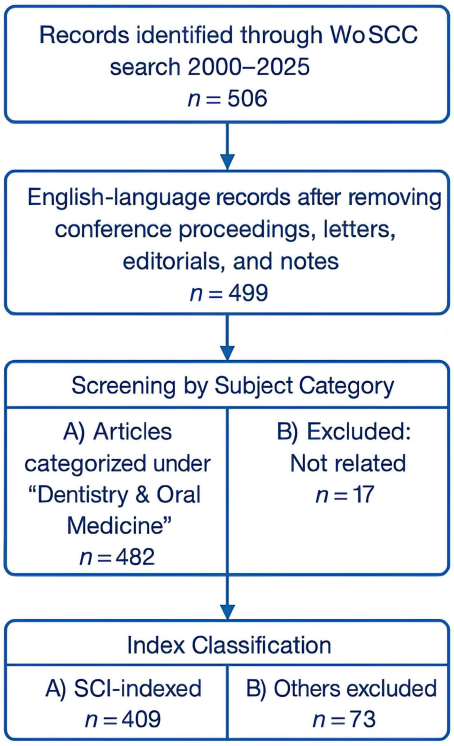

Fig. 1. Flowchart of the Literature Search and Selection Process

VOSviewer to standardize terminology, merging all variations of "*microcomputed tomography*," "*micro computed tomography*," "*micro-computed tomography (scan/scanning)*," "*microct*," "m*icro ct*," "*micro-ct*," and "*microtomography*" under a single unified term, "*micro-CT*", allowing for clearer clustering and a more accurate and visually streamlined map of the keyword network.

In all network maps, the node size represented the frequency of occurrence or publication volume, with larger nodes indicating higher relevance or output. The thickness of connecting lines reflected the strength of the relationships between items, and the color of each node denoted the cluster to which it belonged. All analyses were performed to provide a comprehensive overview of publication trends, influential authors, and thematic developments in the application of micro-CT for root canal morphology research.

3. Results

The refined dataset comprised 499 English-language records; 482 (96.6%) were classified under Dentistry/Oral Medicine and 409 (82.0%) were SCI-indexed. Annual output increased across the study period, with a clear inflection after 2010 and sustained activity through the 2020s. Production followed three phases: 2000–2009, low but steady growth as micro-CT platforms entered dental morphology; 2010–2016, acceleration with wider scanner availability and established workflows; 2017–2025, consolidation at higher volumes with multi-country collaboration networks and recurring morphology themes. The trend line shows no late-period collapse, indicating durable adoption rather than a transient peak (Fig. 2).

The top three countries—Brazil (91; 22.25%), the USA (86; 21.03%), and China (79; 19.32%) accounted for 62.6% of all records. They were followed by Türkiye, Germany, and Switzerland (Table 1).

Publication leadership was held by Versiani, Marco Aurélio (n=32), followed by Sousa-Neto, Manoel Damião (n=21) and Keleş, Ali (n=17). Duarte, Marco AH, Wolf, Thomas Gerhard, and

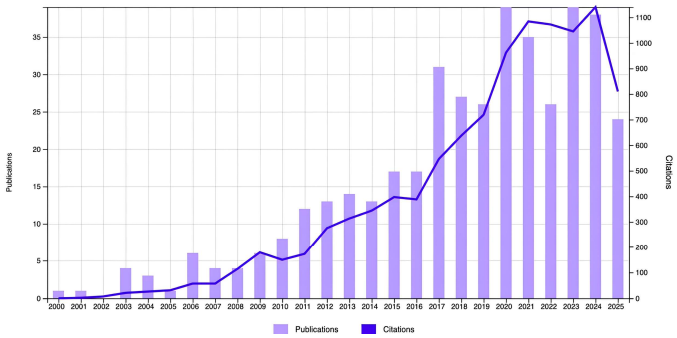

Fig. 2. Yearly output and citation counts (WoSCC, 2000–2025).

Gutmann, James each have 16 publications. Paqué and Ronald have 15, while Keskin and Ahmed have 14 each. The 11-publication gap between the first and second positions indicates a right-skewed distribution with a concentrated top tier and tight clustering in the lower ranks (Table 2).

The co-authorship network comprises 11 distinct clusters (Fig. 3). The largest is Brazil-centered, anchored by Sousa-Neto, Versiani, Ordinola-Zapata, Duarte, and Tanomaru-Filho. A Korean-centered cluster (Lee Jong-Ki, Lee Woo-Cheol, and Oh, Kum) shows strong internal ties but limited external links. Authors like Keleş and Belladonna function as critical bridges, linking multiple diverse clusters across the map. While Ahmed and colleagues form a noticeable sub-cluster, Gu, Y. appears as a small, isolated satellite group, highlighting the specialized and diverse nature of collaboration within this global research field.

The cross-country collaboration network (Fig. 4) revealed strong international partnerships centered around Brazil, China, and the USA, which represented the largest and most interconnected nodes. Germany, Switzerland, Italy, and Türkiye also emerged as key contributors with extensive cooperative links. The dense interconnections among these core countries indicate a highly globalized research landscape, characterized by active knowledge exchange and co-authorship across Europe, Asia, North America, and South America.

As shown in Table 3, the Journal of Endodontics and International Endodontic Journal accounted for the majority of publications (27.1% and 13.9%, respectively), followed by Clinical Oral Investigations and BMC Oral Health.

The keyword co-occurrence analysis (Fig. 5) revealed that 'micro-CT' was strongly linked to 'root canal preparation,' 'anatomy,' and 'cone-beam computed tomography.' After thesaurus merging and a minimum occurrence threshold of 3, three stable clusters predominated: root canal classification, endodontic instrumentation and treatment procedures, and imaging-based anatomical studies. The dense interconnections surrounding 'micro-CT' highlight its pivotal role as a methodological core in endodontic morphology research.

Table 1. Top 10 Authors by Publications

Rank	Author	Publications
1	Versiani, Marco Aurélio	32
2	Sousa-Neto, Manoel Damiao	21
3	Keleş, Ali	17
4	Duarte, Marco AH	16
5	Wolf, Thomas Gerhard	16
6	Gutmann, James	16
7	Paqué, Frank	15
8	Ordinola-Zapata, Ronald	15
9	Keskin, Cangul	14
10	Ahmed, Hany Mohamed Aly	14

4. Discussion

Micro-CT has become a fundamental tool in in vitro endodontic research due to its ability to provide non-destructive, high-resolution, and three-dimensional visualization of internal dental anatomy.[3] The bibliometric analysis conducted between 2000 and 2025 demonstrated a robust and sustained global increase in publications utilizing micro-CT for studies on root canal morphology, with notable geographic and thematic shifts over time.

The bibliometric pattern in Figure 2 demonstrates a three-phase evolution in micro-CT–based endodontic morphology research: (1) 2000–2009 – introduction and methodological validation, (2) 2010–2016 – expansion and scanner diffusion, and (3) 2017–2025 – consolidation and international collaboration. The initial decade showed low but steady growth, coinciding with micro-CT's emergence as a research tool for dental hard-tissue imaging. Early publications emphasized validation and reproducibility compared with histologic and radiographic techniques. Limited scanner access and high costs restricted widespread use, yet the persistence of small-scale studies indicateed that researchers recognized the technology's methodological potential early on.[7, 21] After 2010, studies shifted from proving accuracy to applying micro-CT in complex anatomical and instrumentation research.[22,23] The rising publication and citation curves confirm that micro-CT matured into a standard reference for evaluating shaping effects, canal curvature, and isthmus prevalence. This trend is consistent with the findings of Aksoy et al.[15] who reported a similar inflection point around 2010, marking the transition from validation-based to application-oriented research. However, unlike that earlier analysis, the present study extended the time window to 2025 and reveals that global collaboration intensity and thematic diversity continued to expand rather than stabilize. Similarly, Alfadley et al.[19] demonstrated that endodontic imaging research—especially in micro-CT and CBCT—has shifted toward integrative and data-driven methodologies, which aligns with the increased co-authorship and AI-related keyword emergence observed in our results. The plateau at higher publication volumes in Figure 2 suggests stable, durable integration rather than a transient surge. Multi-country collaboration networks (Brazil, USA, China, Türkiye, Germany, and Switzerland) indicate the field's globalization,

Table 2. Country Contributions

Country/Region	Record Count	% of 409
Brazil	91	22%
USA	86	21%
Peoples R China	79	19%
Türkiye	44	10%
Germany	35	8%
Switzerland	34	8%
Italy	26	6%
Japan	24	5%
South Korea	19	4%

Counts are out of 409 records. Turkey and TURKIYE merged as "Türkiye".

Table 3. Top 10 Journals by Publication Count

Journal	Record Count	% of 409
Journal of Endodontics	111	27.1%
International Endodontic Journal	57	13.9%
Clinical Oral Investigations	29	7.1%
BMC Oral Health	23	5.6%
Australian Endodontic Journal	17	4.2%
Archives of Oral Biology	12	2.9%
Scientific Reports	11	2.7%
Brazilian Oral Research	6	1.5%
Journal of Applied Oral Science	6	1.5%
Journal of Hard Tissue Biology	6	1.5%

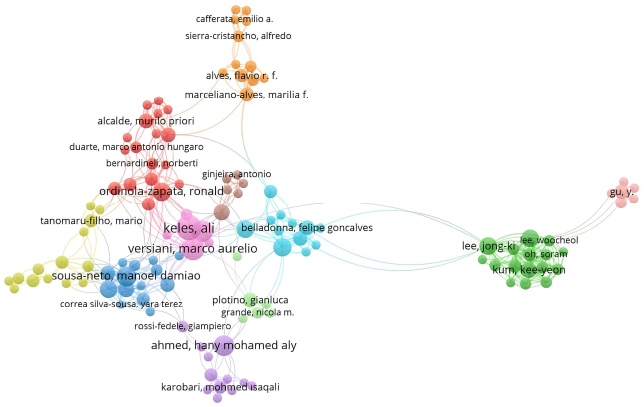

Fig. 3. Co-authorship networks in micro-CT–based endodontic morphology research.

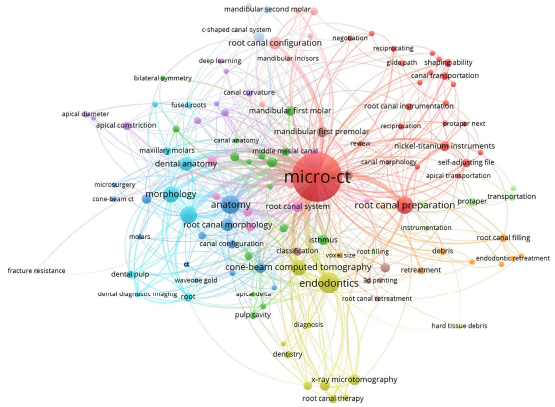

Fig. 5. Node size, link thickness, distances, and colors represent keyword frequency, co-occurrence strength, relatedness, and clusters, respectively.

reflecting how knowledge diffusion and shared data pipelines have enhanced methodological consistency. The sustained citation growth implies that foundational works from the 2010s continued to influence later research, possibly due to integration with digital modeling.[15]

The country distribution highlights Brazil, the USA, and China as the primary contributors, jointly accounting for over 60% of all indexed records. This dominance suggests a mature and well-established research infrastructure within these nations, supported by consistent funding mechanisms, international collaborations, and academic institutions that prioritize high-impact endodontic research.[24,25] Brazil's leadership position aligns with its strong endodontic research network centered around the University of São Paulo and the University of Minas Gerais, where structured postgraduate programs and micro-CT facilities have facilitated large-scale morphological investigations.[25] This institutional strength was further reflected in the productivity of leading Brazilian authors such as Versiani, Sousa-Neto, and Duarte, whose contributions dominate the field and reinforce the country's prominent role in endodontic research. Türkiye's emerging contribution, ranking fourth, underscores the growing capacity of middle-income regions to participate in high-resolution imaging research. The strong presence of European countries such as Germany, Switzerland, and Italy further highlights the global interconnectedness of the field. Overall, these data illustrate that endodontic imaging research has evolved from isolated national efforts into a transcontinental network of shared methodologies and co-authored investigations. The clustering pattern observed in the co-authorship maps corroborates this finding, showing that prolific authors frequently operate within dense, interlinked collaborative groups. The Brazilian-led cluster formed the core of the network, with strong internal cohesion and frequent cross-linkages to European and Asian authors. Peripheral but increasingly active contributors—particularly from Türkiye, China, and Korea—serve as bridges between regional research communities, enhancing global data integration and methodological exchange.

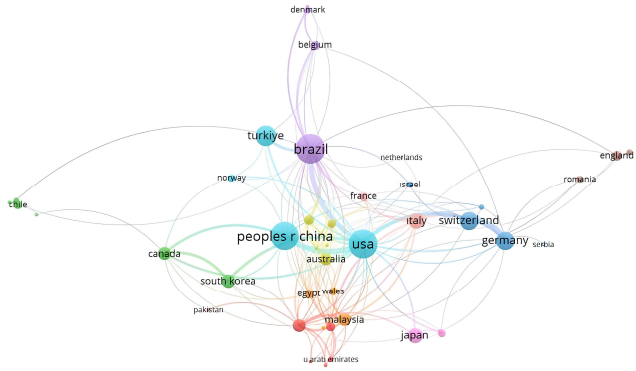

Fig. 4. Cross-country collaboration networks in micro-CT–based endodontic morphology research.

The journal distribution indicated that while endodontic-focused journals dominate the publication landscape, research on micro-CT and root canal morphology also showed substantial representation in broader dental science platforms. The Journal of Endodontics and International Endodontic Journal together accounted for over 40% of all indexed records, confirming their roles as core outlets for methodological and morphological investigations in endodontics. However, the presence of multidisciplinary journals such as Clinical Oral Investigations, BMC Oral Health, and Archives of Oral Biology reflected the cross-disciplinary relevance of micro-CT applications, extending beyond endodontics into restorative, anatomical, and biological research contexts. Similarly, the inclusion of Brazilian Oral Research and the Journal of Applied Oral Science highlighted the integration of endodontic imaging studies within national and general dentistry journals. This distribution suggested that micro-CT-based investigations have become an established methodological approach not only within endodontics but also across the wider field of dental research.

As observed in keyword co-occurrence network, core concepts related to root canal classification, endodontic instrumentation, and imaging-based anatomy were predominantly presented. Frequently recurring terms such as 'root canal configuration', 'curvature', 'instrumentation', and 'cone-beam computed tomography' indicated a research focus that balanced both morphological exploration and clinical applicability. Over recent years, new key terms—such as '3D reconstruction', 'deep learning', and 'digital imaging'—have begun to appear more frequently, reflecting the ongoing integration of computational analysis and artificial intelligence into imaging workflows.[26–28] This trend highlighted a shift toward precision-based endodontics, where imaging data were utilized not only for structural assessment but also for predictive modeling, diagnosis, and treatment optimization. Future studies are expected to expand these interdisciplinary applications, combining advanced imaging with digital technologies to enhance reproducibility and clinical translation in dental research.[29]

Cone-beam computed tomography (CBCT) is another important imaging method used in endodontics for three-dimensional evaluation of root canal anatomy.[30,31] Although CBCT provides valuable clinical information, its lower image resolution compared

to micro-CT limits its use for detailed morphological studies.[32] However, CBCT remains essential for in vivo imaging and clinical decision-making. In recent years, studies combining CBCT and micro-CT have shown that both techniques can complement each other—micro-CT offering precise laboratory data and CBCT providing practical clinical visualization. Together, these technologies support better diagnosis, treatment planning, and understanding of root canal morphology in both research and clinical practice.[7,33]

Although this analysis provided an in-depth look of global publication trends, several methodological limitations were noted. In this study, the data source was limited to the WoSCC and SCI-Expanded publications, which were selected for their high-quality indexing of peer-reviewed journals and compatibility with bibliometric software.[34] Consequently, relevant publications indexed in other databases might have been missed. These exclusions could lead to minor discrepancies in country- or author-level output. Nevertheless, the use of WoSCC and SCI expanded ensures standardized citation tracking, reliable metadata, and methodological consistency, which together strengthen the validity of the present bibliometric assessment.[35] Future research should focus on expanding the integration of micro-CT data with advanced computational methods such as artificial intelligence and digital modeling. Comparative analyses using multi-modal imaging can further validate measurement consistency.

Micro-computed tomography has evolved from a validation instrument into a foundational technology that underpins modern endodontic research. The steady global increase in publications, broad international collaboration, and thematic diversification confirm its sustained scientific and clinical relevance. As the field advances, continued standardization, data sharing, and integration with artificial intelligence are expected to define the next phase of innovation—bridging anatomical insight with clinical application and setting new benchmarks for precision in endodontic science.

5. Conclusion

This bibliometric analysis demonstrates the sustained global growth and methodological maturation of micro-CT–based research in root canal morphology over the past 25 years. The findings highlight the central role of micro-CT as a precise, non-destructive imaging technique that has advanced both anatomical understanding and experimental standardization in endodontics. Ongoing integration with computational tools, digital imaging, and artificial intelligence is expected to further strengthen the reproducibility, accuracy, and clinical translation of future research in this field.

References

1. Mamat R, Nik Abdul Ghani NR. The Complexity of the Root Canal Anatomy and Its Influence on Root Canal Debridement in the Apical Region: A Review. *Cureus*. 2023;15(11):e49024.
2. Pertek Hatipoğlu F, Magat G, Karobari MI, Madarati AA, Tulegenova I, Hatipoğlu Ö, et al. Root and canal configurations of maxillary first premolars in 22 countries using two classification systems: a multinational cross-sectional study. *Sci Rep*. 2025;15(1):19290.
3. Lavanya A, Ali S, Tewari RK. Micro-computed tomography in endodontics. *J Oral Res Rev*. 2023;15(1):80-86.
4. Karobari MI, Batul R, Khan M, Patil SR, Basheer SN, Rezallah NNF, et al. Micro computed tomography (Micro-CT) characterization of root and root canal morphology of mandibular first premolars: a systematic review and meta-analysis. *BMC Oral Health*. 2024;24(1):1.
5. Rhodes JS, Ford TRP, Lynch JA, Liepins PJ, Curtis RV. Micro-computed tomography: a new tool for experimental endodontology. *Int Endod J*. 1999;32(3):165-170.
6. Nielsen RB, Alyassin AM, Peters DD, Carnes DL, Lancaster J. Microcomputed tomography: an advanced system for detailed endodontic research. *J Endod*. 1995;21(11):561-568.
7. Swain MV, Xue J. State of the art of micro-CT applications in dental research. *Int J Oral Sci*. 2009;1(4):177-188.
8. Peters OA, Schönenberger K, Laib A. Effects of four Ni–Ti preparation techniques on root canal geometry assessed by micro computed tomography. *Int Endod J*. 2001;34(3):221-230.
9. Yang G, Yuan G, Yun X, Zhou X, Liu B, Wu H. Effects of two nickel-titanium instrument systems, Mtwo versus ProTaper Universal, on root canal geometry assessed by micro–computed tomography. *J Endod*. 2011;37(10):1412-1416.
10. Alak SG, Keleş A, Keskin C, Martins JNR, Versiani MA. Age-related changes in the morphology of the root canal system of mandibular first molars: a micro-CT study. *Clin Oral Investig*. 2023;27(8):4667-4675.
11. Wolf TG, Rempapi T, Armogida NG, Spagnuolo G, Waber AL. Micro-computed tomographic analysis of the morphology of maxillary canines. *Sci Rep*. 2025;15(1):4111.
12. Nurulaqmar Iwani S, Kamaruzaman M, Jawami AA. Microcomputed tomography (micro-CT) analysis of apical mandibular premolar in relation to clinical sign presentation: an in vitro study. *Saudi Dent J*. 2024;36(1):129-133.
13. Lin X, Fu Y, Ren G, Yang X, Duan W, Chen Y, et al. Micro–computed tomography–guided artificial intelligence for pulp cavity and tooth segmentation on cone-beam computed tomography. *J Endod*. 2021;47(12):1933-1941.
14. Setzer FC, Li J, Khan AA. The use of artificial intelligence in endodontics. *J Dent Res*. 2024;103(9):853-862.
15. Aksoy U, Küçük M, Versiani MA, Orhan K. Publication trends in micro-CT endodontic research: a bibliometric analysis over a 25-year period. *Int Endod J*. 2021;54(3):343-353.
16. Ghavami-Lahiji M, Davalloo RT, Tajziehchi G, Shams P. Micro-computed tomography in preventive and restorative dental research: a review. *Imaging Sci Dent*. 2021;51(4):341.
17. Donthu N, Kumar S, Mukherjee D, Pandey N, Lim WM. How to conduct a bibliometric analysis: an overview and guidelines. *J Bus Res*. 2021;133:285-297.
18. Chen C, Song M. Visualizing a field of research: a methodology of systematic scientometric reviews. *PLoS One*. 2019;14(10):e0223994.
19. Alfadley A, Alfouzan K, Gopinathan PA, Ul Haq I, Alrumi FA, Alahmari AH, et al. Mapping of global research in endodontics from 2004 to 2023: a bibliometric analysis. *Cureus*. 2024;16(12):e75694.
20. Montazeri A, Mohammadi S, Hesari PM, Ghaemi M, Riazi H, Sheikhi-Mobarakeh Z. Preliminary guideline for reporting bibliometric reviews of the biomedical literature (BIBLIO): a minimum requirements. *Syst Rev*. 2023;12(1):239.
21. Dowker SEP, Davis GR, Elliott JC. X-ray microtomography. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1997;83(4):510-516.
22. Verma P, Love RM. A micro-CT study of the mesiobuccal root canal morphology of the maxillary first molar tooth. *Int Endod J*. 2011;44(3):210-217.
23. Ordinola-Zapata R, Bramante CM, Villas-Boas MH, Cavenago BC, Duarte MH, Versiani MA. Morphologic micro–computed tomography analysis of mandibular premolars with three root canals. *J Endod*. 2013;39(9):1130-1135.
24. Pedrazzi V, Dias KRHC, Rode SM. Oral health in Brazil – Part II: Dental Specialty Centers (CEOs). *Braz Oral Res*. 2008;22(Suppl 1):18-23.
25. Melgaço-Costa JLB, Martins RC, Ferreira EF, Paulino Ribeiro-Sobrinho A. Endodontic output in public healthcare under different instrumentation techniques: a quantitative and qualitative study. *Pesqui Bras Odontopediatria Clin Integr*. 2021;21.

26. Lu W, Yu X, Li Y, Cao Y, Chen Y, Hua F. Artificial Intelligence–Related Dental Research: Bibliometric and Altmetric Analysis. *Int Dent J*. 2025;75(1):166-175.
27. Magat G, Altındağ A, Pertek Hatipoğlu F, Hatipoğlu Ö, Bayrakdar İS, Çelik O, et al. Automatic deep learning detection of overhanging restorations in bitewing radiographs. *Dentomaxillofac Radiol*. 2024;53(7):468-477.
28. Aljawhar AM, Ibrahim N, Abdul Aziz A, Ahmed HMA, Azami NH. Micro-computed tomographic evaluation of root and canal anatomy of maxillary first premolars in Iraqi sub-population. *Sci Rep*. 2025;15(1):10821.
29. Lai G, Dunlap C, Gluskin A, Nehme WB, Azim AA. Artificial intelligence in endodontics. *J Calif Dent Assoc*. 2023;51(1).
30. Pertek Hatipoğlu F, Mağat G, Hatipoğlu Ö, Taha N, Alfirjani S, Abidin IZ, et al. Assessment of the prevalence of middle mesial canal in mandibular first molar: a multinational cross-sectional study with meta-analysis. *J Endod*. 2023;49(5):549-558.
31. Almeida JC, Candemil AP, Bertolini GR, Souza-Gabriel AE, Cruz-Filho AM, Sousa-Neto MD, et al. Cone-beam computed tomographic evaluation of the root canal anatomy of the lower premolars and molars in a Brazilian sub-population. *Imaging Sci Dent*. 2023;53(1):77-83.
32. Michetti J, Maret D, Mallet JP, Diemer F. Validation of cone beam computed tomography as a tool to explore root canal anatomy. *J Endod*. 2010;36(7):1187-1190.
33. Chugal N, Assad H, Markovic D, Mallya SM. Applying the American Association of Endodontists and American Academy of Oral and Maxillofacial Radiology guidelines for cone-beam computed tomography prescription. *J Am Dent Assoc*. 2024;155(1):48-58.
34. Birkle C, Pendlebury DA, Schnell J, Adams J. Web of Science as a data source for research on scientific and scholarly activity. *Quant Sci Stud*. 2020;1(1):363-376.
35. Pranckutė R. Web of Science (WoS) and Scopus: the titans of bibliographic information in today's academic world. *Publications*. 2021;9(1):12.

AI Declaration

No generative AI used for writing/analysis/figures. — AI-assisted language editing was used only to improve grammar and clarity. All data collection, screening, analysis, visualization, and interpretation were performed manually and independently verified by the author. No AI tools were used to generate, analyze, or interpret data.

Conflict of Interest

All authors declare no conflicts of interest.

CRediT Author Statement

Ö. B. : Conceptualization, Methodology, Software, Investigation, Data curation, Writing – original draft, Visualization

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